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NATURAL HISTORY OF A TROPICAL, SHRIMP-EATING SPIDER (PISAURIDAE)

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ABSTRACT

Trechalea magnifica (Pisauridae) inhabit small streams in Costa Rica. Except for a few juveniles, these spiders were always active at night. This nocturnal activity may be due to temporal changes in predation risk and food availability. Predation risk was lower at night, whereas food was more abundant during the day.

The diet of this species includes freshwater shrimp, a prey item previously unreported for spiders. These spiders construct hemispherical egg cases and carry them to their spinnerets: characteristics atypical of the family Pisauridae.

INTRODUCTION

The large pisaurid spider *Trechalea magnifica* Petrunkevitch [probably = *T. extensa* (O. P.-Cambridge), James E. Carico, pers. comm.] inhabits small streams in southwest Costa Rica. During the dry season (March 1980) in the Quebrada Camaronal (Corcovado National Park), adult and immature spiders were commonly active at night; but only a few small (immature) spiders were active in daylight. This activity pattern prompted an investigation into why nocturnality might be advantageous to most of these spiders, and why some small spiders diverged from the usual pattern of activity. Possible reasons why most of these spiders were nocturnal include 1) food was more abundant at night and 2) predation pressure on the spiders was higher during the day. This study was designed to evaluate these possibilities. Some aspects of the natural history of the species are also included. In particular, I report the first case of shrimp-eating by a spider and a case of a pisaurid carrying its hemispherical egg sac attached to its spinnerets.

MATERIALS AND METHODS

Trechalea magnifica are well suited for study. They are large and did not flee when approached unless touched on the abdomen or cephalothorax. This behavior allowed me to mark spiders individually by touching a paint brush to unique locations on their legs.

I counted *T. magnifica* resting on stones and logs in a 54 m^2 area during the day and night to determine temporal patterns of spider activity. Spiders on substrates other than stones or logs were extremely hard to find during the day and thus were not censused at either census period.

To determine whether the temporal pattern of spider activity correlated with times of high food abundance, I measured the number of insects available to the spiders during the day and night by smearing square patches of tanglefoot (3 cm on a side) on two sets of twelve stones. One set was placed above the water line among stones in the stream for 10.5 hours at night, the other set was put out for the same amount of time and in the same place during the day. Trapped insects were counted and measured (lengths and widths) to the nearest millimeter.

To estimate the relative abundance of shrimp during the day and night, I measured an index of shrimp activity. For twenty minutes during the day (0900 h) and night (2045 h), I counted the number of shrimp crossing a 1.1 m long by 3-4 mm wide piece of submerged cord. The cord was in the same place during the day and night. Only 'prey-sized' (small) shrimp were counted, and the night count was made using a flashlight covered with red plastic to minimize disturbance to the shrimp. Shrimp activity was thus a function of both shrimp numbers and movements.

The influence of temporal activity pattern on risk of predation on spiders was determined by tethering 40 spiders, 20 during the day and 20 during the night, in their natural habitat. I tethered spiders by carefully tying threads around their pedicels and fastening the loose ends of the thread with tape to stones in the stream. Each group of 20 spiders (half were smaller than 1 cm in body length, half were larger) was left out for three hours (0800-1100 h or 1900-2200 h) after which the remaining individuals were counted. Tethered spiders rested quietly, as did their wild counterparts, since wild spiders did not try to escape until touched. Thus tethered spiders seemed to be reasonable mimics of wild spiders.

I measured spider movements at night by observing 10 small (less than 1 cm in length) and 6 large (greater than 1 cm) individually marked spiders every 15 minutes from 1900 to 2200 h. I searched the same area for the marked spiders the following evening and noted changes in location.

RESULTS

Spider density.—During daytime censuses at 0700 h and 1400 h in the 54 m^2 census plot, I found three and two small spiders, respectively. At night (2100 h) I counted 30 small and 18 large spiders. The densities of spiders during the two daytime censuses appeared lower than in some other parts of the stream. Throughout my study I never saw an adult spider active during the day.

Prey availability and capture.—The number of prey sized insects trapped by tanglefoot during the day and night were similar (18 and 21, respectively) but the total volume of prey trapped [estimated by length times $(width)^2$, assumed to be proportional to biomass] was much higher during the day (118.85 mm^3, day; 28.46 mm^3, night). Even if the largest prey item trapped during the day (a 72 mm^2 spider, the next to largest was 16 mm^2) is excluded, the total prey volume trapped during the day was still twice as large as at night.

Shrimp activity was nine crosses per 20 minutes at night, and 48 crosses per 20 minutes during the day. Consequently shrimp activity, and presumably availability to spiders, was higher during the day.

Predation on spiders.—Of the 20 spiders tethered for three hours during the day, 16 were missing (seven large and nine small), two were being eaten by ants and two were uneaten. Of the 20 spiders tethered at night, one small spider was missing, three were being eaten by ants and 16 were uneaten (eight large and eight small). The 95% confidence intervals of the binomial probability of not being eaten during the day (2/20) and during the night (16/20) do not overlap. Thus predation pressure on *T. magnifica* was considerably higher during the day, and the risk of predation appears equally severe for large and small spiders.

Trechalea magnifica appear to rely heavily on camouflage as a defense mechanism and do not respond to a disturbance around them until actually touched. Most vertebrate predators (birds, bats, lizards) should be able to instantly overpower even the largest spiders. Once a wild spider is found by a vertebrate predator, its chances of avoiding predation are limited. Therefore, although my predation data are most safely described as 'rates of attack' on spiders, they can also be interpreted as 'rates of predation'. However, I did see spiders avoid ants in the field, so predation by ants was probably an artifact of the spiders being tethered. Excluding the spiders eaten by ants from the data does not affect the significance of the results.

Natural history.—The Quebrada Camaronal is a small, shallow stream running through second growth forest. Numerous 'soft-ball sized' stones (some larger, many smaller) fill the edge and shallow parts of the stream. Spiders rest primarily on these stones but also on logs, leaves, and the ground near the stream. The spiders hunt with bodies flattened and all eight legs spread more or less evenly to form a circle. Most large spiders place their first pair of legs on the water's surface, although they can also be found in hunting position at some distance (generally never more than a meter) from the water. Some small spiders also hunt with their first legs on the water, but more commonly they are on top of stones that are in or near the water. This ontogenetic difference in hunting site probably reflects the inability of small spiders to capture the larger, active shrimp and probably in part caused a difference in the prey eaten by large and small spiders. Both large and small spiders fed on arthropods that flew or walked by, whereas large spiders also ate arthropods that floated on the water's surface and aquatic prey.

Williams (1979) reported that some pisaurids wait quietly for passing prey, whereas others dash out to capture more distant prey. *T. magnifica* seemed to follow the former strategy.

I often saw spiders catch or attempt to catch insects attracted by my headlamp. Attacks consisted of quick, short lunges, usually no more than two leg-lengths away. Pisaurids do not require vision for prey capture, and can detect the buzzing of winged insects (Williams 1979).

I saw at least half a dozen large spiders feed on the abundant fresh water shrimp in the stream. As far as I can determine, this is the first report of a spider that feeds on shrimp. Spiders have been reported to feed on birds (Bates 1876:83), mice and snakes (Gudger 1925), and isopods and amphipods (Lamoral 1968), in addition to insects and arachnids. Members of the family Pisauridae are well known for their ability to catch and eat fish (Gudger 1925, Williams 1979). I never saw the spiders feeding on fish, even though fish appeared as abundant as shrimp in the stream. Although I never saw a spider actually catch a shrimp in the field, a captive spider did capture a live shrimp (actual capture not observed). I often watched shrimp swim very near a hunting spider with no apparent response from the spider, therefore I assume that the spiders detect shrimp only when shrimp actually brush the spiders' legs (Williams 1979).

During the short time period of this study, the spiders appeared to be very site specific. On the night I monitored spider movements all of the spiders I watched remained within a one meter radius. Ten of the 16 spiders never left the rock on which they were resting, four of the remaining six moved only once, one moved twice, and a large gravid female moved four times. The following night at 2015 I relocated nine of the 16 spiders. All but one large spider were within 10 cm of where I had observed them the night before. The large spider had moved about 5 m upstream.

Although I did not search for spiders in their diurnal retreats, I assume for two reasons that they spend the day at some distance from their nocturnal hunting sites. First, I saw many large spiders hunting from rocks that seemed far too small for then to hide under. Second, many spiders hunted from stones that were partially submerged and surrounded by water. Although pisaurids often escape predation by submerging (Williams 1979), the spiders probably do not spend the day under water.

These spiders seemed particularly incautious in the face of a large, potentially dangerous predator—myself. That they did not flee when touched on the legs probably explains the numerous spiders I saw with one to three legs missing. The large gravid female spider mentioned above was a conspicuous exception. She frequently dashed across the water when I approached, and would not allow me near enough to mark her. Also, spiders appeared to be more wary when they first emerged at sunset.

Maternal behavior in *T. magnifica* is unusual. Females construct hemispherical egg cases and carry them on their spinnerets. These properties are more characteristic of the closely related Lycosidae. In fact, pisaurids are often distinguished from lycosids by the round egg cases the pisaurids construct and carry with their chelicerae and pedipalps (Comstock 1913:602, Kaston 1978). *T. magnifica* are atypical of the family in this respect.

DISCUSSION

Nocturnal activity at exposed sites by *Trechalea magnifica* was not associated with higher food levels. In fact the opposite was true: food—both shrimp and other arthropods—was more abundant during the day. In contrast, nocturnal activity resulted in a far lower predation risk than diurnal activity. Consequently, nocturnal activity was less advantageous for food procurement, but highly advantageous for predator avoidance.

I observed several potential predators during the daytime near the stream. Insectivorous birds and basilisc lizards were quite abundant, and large wasps were not uncommon. Carico (1973) reported that pompilid and sphecoid wasps are predators on *Dolomedes tenebrosus* (Pisauridae) in temperate areas.

The low rate of predation on spiders during the night was unexpected because there were numerous potential nocturnal predators. I saw mygalomorph and lycosid spiders at night and bats in the gleaning carnivore guild were probably common in the area. Bonaccorso (1979) reported that these bats were common on Barro Colorado Island, Panama, an island that is climatically similar to Corcovado National Park. Gleaning carnivores pick their prey off leaves and the ground. Perhaps the flattened profile assumed by *T. magnifica* while hunting allows them to avoid detection by a bat's sonar.

Why are some small spiders diurnally active despite high predation risks? My data do not provide a clear resolution, but suggest the following hypothesis. The scarcity of food at night may be more severe for small spiders because large spiders can eat shrimp as well as other arthropods. Perhaps food levels were so low for the small spiders that they risk high predation during the day to take advantage of the higher diurnal insect abundance. Small spiders might have been able to use small inconspicuous sites for hunting that were not available to large or tethered spiders. Thus I suspect that predation was not as severe on small spiders during the day as my data suggest.

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LITERATURE CITED

Bates, H. B. 1876. The naturalist on the river Amazons, fourth edition. John Murray, London. Reprinted by Dover, New York, 1975. 394 pp.

Bonaccorso, F. J. 1979. Foraging and reproductive ecology in a Panamanian bat community. Bull. Florida St. Mus. Biol. Sci., 24:359-408.

Carico, J. E. 1973. The nearctic species of the genus *Dolomedes* (Araneae: Pisauridae). Bull. Mus. Comp. Zool., 144:435-488.

Comstock, J. H. 1913. The spider book. Doubleday, Page and Co., New York. 721 pp.

Gudger, E. W. 1925. Spiders as fishermen and hunters. Natural History, 25:261-275.

Kaston, B. J. 1978. How to know the spiders, third edition. Wm. C. Brown Co., Dubuque. 272 pp.

Lamoral, B. H. 1968. On the ecology and habitat adaptations of two intertidal spiders, *Desis formidabilis* (O. P.-Cambridge) and *Amaurobioides africanus* Hewitt, at "The Island" (Kommetjie, Cape Peninsula), with notes on the occurrence of two other spiders. Ann. Natal. Mus., 20:151-193.

Williams, D. S. 1979. The feeding behaviour of New Zealand *Dolomedes* species (Araneae: Pisauridae). New Zealand J. Zool., 6:95-105.

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